Antipredator Behavior in *Octopus dofleini* (Wülker)

BY

B. HARTWICK, G. THORARINSSON AND L. TULLOCH

Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia V5A 1S6, Canada

THE GIANT PACIFIC OCTOPUS, *Octopus dofleini* (Wülker, 1910), is a large and active predator in the marine subtidal. In spite of its own predaceous habits the octopus itself is a victim of attacks by a variety of other predators including seals (KENYON, 1965), sea otters (KENYON, 1975), dogfish sharks (BROCKLESBY, 1927), lingcod (Brian Francis, pers. comm.) and, of course, man.

During a study of the population ecology and behaviour of *Octopus dofleini* on the west coast of Vancouver Island, we recorded considerable evidence of predation on these organisms. Of 39 octopuses weighing between 0.37 kg and 18.2 kg collected subtidally in Clayoquot Sound, 66% had considerable scarring and 50% had partially amputated arms. This evidence along with reports from local divers who observed unidentified fish attacking a medium-sized octopus (Harley Regan, pers. comm.) suggests that octopuses are not the top carnivores that they would seem to be.

As PACKARD (1963) and others (see for example, YOUNG, 1958) have suggested the octopus is an animal which has a den for a base which it leaves to attack prey, and into which it withdraws if disturbed. The behaviour of an octopus can then be interpreted in terms of visual responses involving an approach response and a withdrawal response (PACKARD, 1963). Packard gives the components of these responses for *Octopus vulgaris* as well as providing an interpretation of other behaviour patterns including a sucker display, as responses lying along an approach-withdrawal axis. Although species like *O. vulgaris* have been well-studied, especially in the laboratory, similar observations are lacking for *O. dofleini* and reports on their behaviour in their natural environment are almost non-existent. After KYTE & COURTNEY (1977) reported their observation of aggressive behaviour in *O. dofleini,* we attempted to compile our own observations on this animal. We have approached octopuses of various sizes in the dens and in the open; in some cases just to clear shells from a den and at other times to actually remove the octopus in an experimental harvest program.

During our studies of *Octopus dofleini* we have checked many dens. The octopus inhabiting a den usually observes our activities around the den entrance with one eye only. In some cases one arm would uncurl out toward a diver and then withdraw back into the den. Aggressive encounters were rare but several are reported later in this paper. In one case an octopus weighing approximately 2 kg was sufficiently disturbed by our collecting of shells at the den, to jet quickly away only to settle about 5 m above the den where it remained motionless. Moving away quickly or remaining motionless are two responses observed in *O. dofleini* and reported commonly in species like *O. vulgaris.* PACKARD (1963) describes the components of the withdrawal response of *O. vulgaris.* The head is depressed, the body blanched except for darkening around the eye and suckers, and the arms are curved back and upward. The funnel is directed at the stimulus. In our encounters with *O. dofleini* the octopus if approached in the open would usually remain cryptic and motionless as long as the diver remained some distance away. If this reactive distance was breached then the animal would flee. The distance at which an animal reacts by fleeing varied from a meter to almost nil. In one case an octopus estimated to be 4.5 kg was found in the open and it remained motionless even when the mantle was caressed. Numerous papillae were raised, however.

Some of our best observations of antipredator behaviour have arisen during the experimental harvesting project. In each case an occupied den had bleach squirted into it. The divers would then move off behind rocks to await emergence of the octopus. Puffs of silt from the den opening indicated that the animal was about to emerge. The octopus leaves the den and stops a meter or so outside. On seeing the divers the body of the octopus moves quickly down in what appears like a "ducking" movement. Since the octopuses view the diver with one eye only this movement may give some estimate of distance. With the first bob, the animal blanches. The whole body pales including the area around the eyes; unlike *Octopus vulgaris* which darkens the area around the eyes. The octopuses then spread their interbranchial webbing in one fluid motion by thrusting the arms out and backward although the tips are kept curled in close to the body. The octopus remains immobile in this position for several seconds after which it moves quickly back into the den

or some other nearby hole if possible. If a den or hole is not accessible, the octopus swims up and away, often ejecting ink directly at the diver. An octopus that has settled on the bottom after being chased has prominent horns behind the eyes and swollen papillae on its mantle.

The dramatic display described above presumably startles a potential predator and permits the escape of the octopus. Interestingly the display had this effect on the divers at least in the first few instances and actually enabled the animals to escape. Often the octopus would retreat quickly back into its den immediately after the display. The display certainly gives the animal an appearance of much larger size. Small octopuses did not give a complete display. Although they became pale, they did not extend their arms and usually they were very quick to flee. Such a response would seem appropriate for animals which would be relatively small even in full display.

Although High (1976) suggested that the behaviour of *Octopus dofleini* was unpredictable, the observations we have made indicate predictable responses under certain circumstances.

We did not observe any sucker displays in *Octopus dofleini*. The sucker display described in *O. vulgaris* by Packard (1961) is presumed to be an intraspecific display. A photograph of *O. dofleini* in High's paper shows some resemblance to this display but no other evidence exists. However, measurements of maximum sucker size on arms of 39 specimens of *O. dofleini* indicate that the largest suckers in males are proportionately larger than those in the female (Hartwick, 1977) and it may be that such a display is used during mating activities.

In addition to the withdrawal display described earlier, octopuses show a particular attack or approach response. Packard (1963) describes this for *Octopus vulgaris* as a deep brownish-reddening of colour combined with orientation changes. We observed an octopus in the open and holding a crab; the colour of the octopus appeared as deep brown. Kyte & Courtney (1977) described a similar mottled reddish-brown colour for an octopus attacking another octopus; the opponent appeared blanched. Although we have not seen any aggressive encounters between octopuses we have had such interactions with the animals ourselves. On October 24, 1976, two divers descended to a den located at 18 m. Two large octopuses were present, one just inside the den, the other in front of the den. The one in front on seeing the divers several meters away moved up off the bottom spreading its webbing and arms and taking on a dark brownish appearance. It then moved toward the divers and in fact kept advancing even when the divers had retreated to a ledge at 10 m. On Nov. 2 both octopuses were present inside the den which was actually a horizontal crevice. When we started to collect shells near the den one octopus moved out of the den towards us but stopped several meters away and then moved back into the den. On February 11, 1977 a light was shone into the same den which now held only one large octopus estimated to weigh 20 to 30 kg. The octopus came directly out at the divers and when emerging had an almost black colouration. Once out of the den, the octopus swam about 1 m above the den in a single burst and extended all 8 of its arms; an unusual case since whenever we had encountered other octopuses in midwater their reaction was to flee immediately leaving behind a trail of ink. No paling was observed by the divers and when the octopus settled to the ledge in front of the den its colour appeared totally black or very dark brown. The octopus then crawled toward the divers. Such aggressive encounters are of great interest. The battle observed by Kyte & Courtney (*op. cit.*) occurred in January and may have been related to reproductive activities or territoriality during the mating season. Although we have no evidence of territoriality in *O. dofleini*, their general level of aggression may be higher in late fall and early winter which is presumably the normal mating period. In fact, commercial divers (Rod Palm, pers. comm.) have reported a much higher frequency of attacks during this time.

The full significance of this and other behaviour patterns in *Octopus dofleini* will only be understood through continued recording of observations of their behaviour in the natural environment.

Literature Cited

Brocklesby, H. N.
1927. Determination of vitamin A content in liver oil of the dogfish *Squalus sucklii*. Con. Chem. Metal. 11: 238 - 239

Hartwick, E. B.
in prep. Morphology of *Octopus dofleini*

High, William L.
1976. The giant Pacific octopus. Mar. Fish. Rev. 38 (9): 17 - 22

Kenyon, K. W.
1965. Food of harbour seals at Amchitka Island, Alaska. Journ. Mamm. 46: 103 - 104
1975. The sea otter in the eastern Pacific Ocean. Dover Pub. Inc. New York, 352 pp.

Kyte, Michael A. & Gregory W. Courtney
1977. A field observation of aggressive behavior between two North Pacific Octopus, *Octopus dofleini martini*. The Veliger 19 (4): 427 - 428; 1 plt. (1 April 1977)

Packard, Andrew
1961. Sucker display of octopus. Nature, London 190: 736 - 737
1963. The behaviour of *Octopus vulgaris*. Bull. Inst. Oceanogr. Monaco, No. spec. 1D: 35 - 49

Young, J. Z.
1958. Responses of untrained octopuses to various figures and the effect of removal of the vertical lobe. Proc. roy. Soc. Belg. 149: 463 - 483